Demystifying Lexical Inferencing: The Role of Aspects of Vocabulary Knowledge

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This empirical study examines how English-as-a-second-language (ESL) learners use their vocabulary knowledge for inferring meanings of unknown words in reading comprehension. The data, collected through interviews with young adult ESL students in Canadian universities, indicate that: (a) semantic and morphological aspects of vocabulary knowledge play an important role in learners' comprehension processes; (b) a positive relationship exists between certain aspects of learners' vocabulary knowledge and their lexical inferencing ability; and (c) in processing the meaning of unknown words, all learners looked for cues to meaning, but learners with varying depths of vocabulary knowledge tended to focus on varying strategies.

Cette étude empirique porte sur la façon dont les élèves d'ALS s'appuient sur leur connaissances lexicales pour inférer le sens de mots écrits qui leur sont inconnus. Les données proviennent d'entrevues auprès de jeunes adultes, étudiants d'ALS dans des universités canadiennes, et elles indiquent que : (a) les aspects sémantique et morphologique des connaissances lexicales jouent un rôle important dans les processus de compréhension des étudiants; (b) un rapport positif existe entre certains aspects des connaissances lexicales des étudiants et leur capacité à faire des inférences lexicales; et (c) quand ils traitent le sens de mots inconnus, tous les étudiants cherchent des indices quant au sens, mais leurs stratégies varient selon leurs connaissances lexicales.

Introduction

It is well known that vocabulary knowledge plays an important role in the process of reading comprehension (Alderson, 2000; Anderson & Freebody, 1981, 1983; Mezynski, 1983; Stratton & Nacke, 1974). But what is meant by knowing a word? "Word meanings can be 'known' to varying degrees" (Mezynski, p. 265), and varying situations may require varying levels of vocabulary knowledge. In order to understand what vocabulary knowledge is composed of, researchers (Cronbach, 1942; Nation, 1990, 2001; Richards, 1976) have made various, yet complementary, proposals defining vocabulary knowledge. Recent research proposes that vocabulary knowledge should be regarded as having a breadth dimension as well as a depth dimension (Chapelle, 1998; Qian, 1999, 2000, 2002; Read, 1989, 2000; Wesche & Paribakht, 1996). Breadth of vocabulary knowledge refers to vocabulary size,

or the number of words of which a language user has at least some superficial knowledge of their meaning. Depth of vocabulary knowledge relates how well one knows a word.

Qian (2002) proposes that a framework of vocabulary knowledge should contain four dimensions: vocabulary size, depth of vocabulary knowledge, lexical organization, and automaticity of receptive and productive vocabulary knowledge. According to Qian, the dimension of depth of vocabulary knowledge comprises various aspects of lexical characteristics such as phonemic, graphemic, morphemic, syntactic, semantic, collocational, and phraseological properties. In the reading process, these aspects of knowledge interact with and inform one another so that the best comprehension results can be achieved. Three empirical studies (Qian, 1999, 2000, 2002; Qian & Schedl, 2004) involving 498 international students of ESL indicate that depth of vocabulary knowledge plays an important role in the reading comprehension process. It is, therefore, essential to consider the role of depth of vocabulary knowledge when one talks about ESL reading comprehension.

Lexical Inferencing

In L2 reading research, lexical inferencing refers to making informed guesses about word meaning based on available cues, linguistic or nonlinguistic, and various aspects of the learner's knowledge. Except one study (Bensoussan & Laufer, 1984), which found that level of language proficiency had little effect on the outcome of lexical guessing, L2 reading researchers generally posit that L2 learners' ability to guess unfamiliar words is directly affected by their proficiency levels in that particular language: High proficiency (HP) L2 learners normally make more successful guesses than low proficiency (LP) L2 learners (dos Santos & Sanpedro Ramos, 1993; Haastrup, 1991; Haynes, 1993; Morrison, 1996). According to dos Santos and Sanpedro Ramos, who looked into the differences between good and poor readers in a study of 140 ESL students attending a Brazilian university, poor readers tend to overuse top-down processing strategies, and the results of their guessing are often less than satisfactory. This finding is in line with the results obtained by Morrison, who, based on a study of 20 English-speaking, first-year university students of French as a second language (FSL) in Canada, reported that LP learners tended to overuse world knowledge as an information source, that HP learners were more capable of using a variety of linguistic knowledge sources than LP learners, and that at a success rate of 74%, HP learners were more successful in guessing the meaning of unknown words than were LP learners, who achieved a success rate of only 34%. In her study of 63 adult ESL learners from four linguistic backgrounds, Haynes found that lack of vocabulary knowledge was a major factor hindering her learners in performing lexical guessing tasks satisfactorily, and attending to word form was a popular strategy among ESL learners, but mismatches often happened, espe-

cially with LP learners. Cziko (1980), based on the results of his study of oral reading errors with two proficiency-level groups of FSL students and one group of native French speakers, reported that LP learners tended to focus more on surface graphemic shape and less on contextual information indicating syntactic, semantic, or discourse constraints.

Knowledge Sources Involved in Lexical Inferencing

Based on the data from their introspective, retrospective, and delayed retrospective verbal protocols of 10 ESL learners with a variety of L1 backgrounds (including French, Chinese, Persian, Spanish, Vietnamese, and Arabic), de Bot, Paribakht, and Wesche (1997) identified a set of eight knowledge sources used in inferring meanings of unknown words in reading comprehension processes. These were sentence level grammar, word morphology, punctuation, world knowledge, discourse and text, homonymy, word associations, and cognates. They found that morphosyntactic information was the most frequently used knowledge source for their learners: The number of times knowledge of sentence grammar and word morphology was applied accounted for 34.6% and 15% respectively of the total number of occurrences in which the learners resorted to their knowledge sources.

Using think-aloud protocols among pairs of students, Haastrup (1991) studied the lexical inferencing procedures of high school students who were Danish-speaking learners of English. In developing a taxonomy of knowledge sources for her data analysis based on Carton's (1971) framework of knowledge sources for inferencing, Haastrup identified three main sources of knowledge L2 learners may use in lexical inferencing: contextual, intralingual, and interlingual. In her taxonomy Haastrup divided contextual knowledge into two subcategories: knowledge of co-text and knowledge of the world. Here co-text refers to context of various lengths that surround a target word. The second source of knowledge, intralingual knowledge, was divided into two categories: the test word itself and the syntax of the sentence containing the test word. Under the category of test word, six subcategories were established: (a) phonology/orthography, (b) morphology, (c) lexis, (d) word class, (e) collocations, and (f) semantics. Under the category of the syntax of the sentence containing the test word, four subcategories were identified: (a) definite articles, (b) adjectives, (c) prepositions, and (d) number. The third source of knowledge, interlingual knowledge, contained two categories, which were L1 and Ln. Ln refers to all other languages except the informants' L1 and the target language of the experiment (see Haastrup, pp. 92-100, for details). Among her findings Haastrup noted that contextual knowledge was the most heavily used source of knowledge by her informants, use of intralingual knowledge ranked second, and interlingual knowledge was relatively infrequently used. At the subcategory level, the most heavily used information sources were co-text, or context of various lengths

surrounding the test word. Test word came as the second-heavily used source. World knowledge was the third-heavily used source. The least used knowledge sources were Ln and syntax of the sentence containing the test word.

Morrison's (1996) study partly replicated Haastrup's (1991) study, using pair think-aloud processes to infer lexical meanings. At the level of main knowledge sources and based on the total number of 40 valid attempts at lexical inferencing made, Morrison found that her results generally corroborated Haastrup's with respect to frequencies of use of knowledge sources. At the subcategory level, whereas co-text was still the most heavily activated information source in the lexical inferencing process—a finding conforming to that of Haastrup—Morrison noted that knowledge of the world was the second most frequently used source, and knowledge of the test word was a distant third source. These results partly match Haastrup's findings.

The Present Study

In the context of examining the role of various aspects of the dimension of depth of vocabulary knowledge in reading comprehension, the present study was conducted to obtain insights into how ESL learners make lexical guesses while reading. More specifically, the study, accomplished mainly through individual interviews, was designed to address the following research question: How do ESL learners make use of aspects of their vocabulary knowledge in the process of comprehending a general academic text?

This research question was further divided into two more specific research questions as follows.
1. What knowledge sources do ESL learners normally use in inferring the meaning of unknown words in a written text?
2. What aspects of vocabulary knowledge do ESL learners normally use in their lexical inferencing processes while reading?

Method

Participants

The participants were a subsample randomly recruited from a larger sample of ESL learners involved in a study on the relationship between vocabulary knowledge and reading performance (Qian, 1999). The participants were all students attending intensive ESL courses at two universities in southern Ontario. This subsample consisted of 12 learners. All were recent arrivals in Canada. Their average duration of stay in Canada had been three months by the time the data-collection started. Their average age was 24 years. Ten of the learners spoke Korean as their L1, whereas the other two were Chinese speakers. The vocabulary knowledge levels of these 12 participants were

determined and ranked according to their test scores on the *Depth of Vocabulary Knowledge Test* (Qian, 1999, 2002), revised from Read's (1993) *Word Associates Test*. Other demographic information about these participants is provided in Table 1.

Material and Instruments

Experimental sentences and text

The present study was conducted in the form of semistructured individual interviews based on four complex sentences and a short text on greenhouses. The sentences and text were prepared on the assumption that they would contain words unknown to some of the participants. Four experienced ESL teachers, including two native English speakers and two non-native English speakers, were invited to select and then evaluate the suitability of the experimental text in order to ensure that the contextualized meanings of the target words were indeed inferable and that helpful clues beyond the morphological cues contained in the target words were available at varying levels for inferring the meanings of most target words. In the experimental text, 10 words were highlighted. They were *greenhouse, feature, indispensable, edible, irrespective, permanent, functional, conduct, devices,* and *free-standing*. Presumed unknown to the participants, these words accounted for about 7% of the total number of words of the text. Except for the word *greenhouse*, which appeared three times, all the other target words appeared only once in the text. The 7% density was therefore based on 12 occurrences of the highlighted words. These 10 words were intended as stimulus words, or test

Table 1
Participants' Ranks Based on Their Depths of Vocabulary Knowledge

Participants' Ranking	L1	Age	Sex	Education level	DVK Score (max. possible: 160)
#1	Korean	41	female	univ grad	142
#2	Korean	22	female	univ 4th yr	135
#3	Korean	22	female	univ 4th yr	135
#4	Korean	25	female	univ grad	133
#5	Korean	25	female	univ grad	127
#6	Korean	24	male	univ 4th yr	125
#7	Korean	23	female	univ grad	124
#8	Korean	25	female	univ grad	121
#9	Korean	19	female	univ 2nd yr	114
#10	Korean	23	male	high school	110
#11	Chinese	38	male	univ grad	107
#12	Chinese	30	female	univ grad	94

words, to elicit responses from the interviewees in order to determine: (a) whether they understood the correct meaning of these words, and (b) if these words were unknown to them, what knowledge sources the participants would use in trying to guess the meaning of these words in the comprehension process.

A pilot study was also carried out with four learners of varying English proficiency levels to ensure that ESL learners of intermediate or high-intermediate level would not normally know these words, but would be able to infer the meaning of some of these items with the help of clues from the text.

Interview questions

A set of questions was used in the interviews to understand how the participants made use of their vocabulary knowledge in comprehending the text and what sources of knowledge they used in the comprehension process. These questions, listed below, were used in conjunction with the experimental sentences and text. The participants were asked some or all of the following questions depending on the stimulus words chosen and the availability of interview time.

- How do you explain this sentence in your own words?
- What is the meaning of ____ (a stimulus word) in this sentence?
- Why did you think this was the meaning of the word here?
- Did you consider other meanings before deciding on this one?
- You have indicated you did not know this word. So how did you work out the meaning of this word?
- What information helped you understand this sentence?
- Is there anything else that helped you understand this sentence?

More specific questions were developed based on these generic questions after the stimulus words were finalized at the beginning of each interview.

Procedures

All individual interview sessions took place between only the researcher, who served as the interviewer, and the interviewee. Coming from high-intermediate English level classes, most participants spoke fluent English except the two Chinese learners, who preferred to be interviewed in their L1. As a precaution, those interviewed in English were informed beforehand that they could also write down the meaning of the stimulus words in their L1 in addition to their oral explanations if needed. At the beginning of each interview session, the interviewer asked the learner to underline all unknown words in the four experimental sentences. Then the learner would be given a few minutes to work out the meaning of each sentence. After the learner indicated that the task was completed, the interviewer would ask the learner to explain the meaning of the whole sentences as well as some specific words in the sentences. The words the learner had underlined usually became the

focus of the questions that the interviewer asked based on the generic questions described above.

Then the learner would be presented with the experimental text in printed form and asked first to read through the text silently and then underline any unknown words in the text. After this the learner would be asked to describe the main idea of the text and then answer questions about the test words. Words underlined by the interviewee all qualified as test words. When some of the 10 highlighted words in the experimental text were underlined by the interviewee, these normally became the focus of questions. Occasionally the interviewer would add a small number of test words for probing when noticing that the learner did not present correctly the general idea of the experimental text, probably due to misunderstanding some words. Each interview lasted about 45 minutes on average. All the interviews were audiotaped and later transcribed.

Data Analysis

Analyses of the interview data were primarily descriptive-interpretive. In order to obtain insights into the role that aspects of vocabulary knowledge play in the reading comprehension process, the interview data were first analyzed qualitatively using content analysis to address the two specific research questions described above. Quantitative analyses were also carried out after the qualitative data were coded and quantified. The data were analyzed by two raters, both experienced ESL teachers and researchers. The interrater agreement was 85%.

The interview data were coded and analyzed according to the following framework, grounded in the definition of the dimension of depth of vocabulary knowledge (Chapelle, 1998; Qian, 1999, 2002; Qian & Schedl, 2004), as well as on some relevant features of two other taxonomies of knowledge sources for lexical inferencing (de Bot et al., 1997; Haastrup, 1991). For example, Part 1 of the framework, Location of the Clues, was developed in line with Haastrup's idea of co-text. Although it is debatable whether conceptually co-text should be regarded as a knowledge source, there is an advantage in including it as a separate category in the present framework to indicate locations of clues. From a practical point of view, this category can provide valuable information revealing how far afield the learner has found clues— from the test word per se, from words surrounding the test word in the T-unit, or from beyond the T-unit. Therefore, the category of location of clues was included here simply to locate clues used in learners' lexical inferencing.

All the analytical categories were finalized after a preliminary analysis of the interview data in order to ensure that only knowledge sources that had actually been consulted in the inferencing processes were listed in the framework, to avoid unnecessary clumsiness. The finalized framework appears as follows.

1. Location of clues:
   a. Clues within the test word (see the analysis of Example 1 below);
   b. Clues from the immediate context, that is, the T-unit containing the test word;
   c. Clues beyond the immediate context.
2. Knowledge of the world, which includes factual knowledge, attitudes, beliefs, and prejudices.
3. Intralingual vocabulary knowledge:
   a. Phonological/orthographic forms. The learner compares phonological or orthographic similarity of a test word and other words in inferring the meaning of the test word.
   b. Morphology. The learner uses morphological clues in a test word to infer its meaning. Such clues may include the stem, inflections, derivational affixes, other word formation devices, and the part of speech of the word.
   c. Syntax. The learner uses syntactic clues from the T-unit surrounding the test word to infer the meaning of the test word. Such clues may include the position of the test word and its collocational and other syntagmatic relations with other words in the T-unit.
   d. Meaning. The learner works on the appropriate meaning of a test word based on the meaning of the written context using, where applicable, clues indicating polysemy, antonymy, synonymy, or other paradigmatic relations the word may have. Clues of this type may extend beyond the immediate context of the T-unit.
4. Interlingual knowledge. The learner uses his or her L1 knowledge in inferring the meaning of a test word.

Valid Attempt and Rate of Success

The present analysis adopts the principle that an attempt at lexical inferencing is taken as valid if there was sufficient discussion about a test word allowing for a categorization according to the taxonomy. One valid attempt can include a single or multiple response, that is, it can be associated with the use of one or more knowledge sources. The following example was deemed a valid attempt at inferring the meaning of *readout*, because the response given by the learner to the question on the test word *readout* indicated that he was trying to work out the meaning of the word with clues within the test word (*it sounds like "read-it-out"*), clues from the immediate context (*So the word "digital" is important here*), his knowledge of the world (*It's like the display on our digital watches*), and his knowledge of word formation devices.

Example 1

[T-unit: These portable meters give digital readouts that indicate the difference between a plant's temperature and that of the surrounding air.]

Learner:	Eh … it sounds like "read-it-out." I thought it had something to do with digits, so I put it into display. It's like the display on our digital watches.
Interviewer:	When you were guessing the meaning of "readouts," did you consider any other meanings before deciding on "digital display," or was it your first reaction?
Learner:	It was my first reaction because I've seen a lot of electronic clocks and watches, they are all related to numbers. So the word "digital" is important here. (Transcript #18)

The following example was not deemed a valid attempt because the learner's response to the question indicated that he could not guess the meaning of the test word *indispensable*.

Example 2

[T-unit: The greenhouse is a common feature in many gardens and is indispensable to the gardener, as it provides near-perfect conditions for plants, both edible and ornamental, all year round, irrespective of the weather.]

| Interviewer: | The first word is "indispensable." Can you guess its meaning? |
| Learner: | No. (Transcript #18) |

Results

In total, 67 valid attempts were identified according to the above definition of valid attempt. Also, 47 cases were considered invalid attempts because although the questions on these words were asked, participants were either unable to work on these words or the responses to the questions did not contain sufficient information for categorization according to the analytical framework. Table 2 lists all the test words used in each individual interview. The 30 underlined words stand for the cases in which lexical inferencing attempts were successful. Based on the 67 valid attempts made by the 12 participants, the overall success rate was therefore 30/67 = 45%. The success rates for individual participants ranged from 13% to 100%. In Table 2 all test words involved in successful attempts are highlighted.

Knowledge Sources Used in Lexical Inferencing

In lexical inferencing, one attempt may involve a number of knowledge sources. In the above Example 1, in order to infer the meaning of the test word *readout*, the learner used morphological clues within the test word, as well as his world knowledge based on contextual clues within the T-unit containing *readout*. In this case two knowledge sources are deemed to have

Table 2
List of Test Words Used in the Valid Attempts

Participant	Test words used in the valid attempts
1	contention, indispensable, *irrespective, free-standing*
2	potent, *ornamental, prone, deteriorate,* conduct
3	*readout,* contention, *sound, functional, prone, deteriorate,* conduct, *device,* free-standing
4	*potent, permanent, functional*
5	potent, prejudice, contention, *greenhouse,* indispensable, edible, irrespective
6	contention, *functional, free-standing*
7	contention, *ornamental, irrespective, functional, prone*
8	potent, *free-standing,* conduct
9	emotion, indispensable, *permanent,* decorative, deteriorate, conduct, *free-standing*
10	potent, *cereal,* sound, *decorative,* prone, conduct, free-standing, deteriorate
11	*readout, prejudice,* contention, literally, *deteriorate*
12	potent, portable, digital, contention, rejection, *prone,* greenhouse, feature
	Total: 67 valid attempts

Note. Words in italics indicate successful attempts.

been activated, namely, morphology and knowledge of the world. Among the 67 valid attempts, 53 attempts involved only one knowledge source, 11 attempts involved two knowledge sources, and three attempts involved three knowledge sources.

The knowledge sources the participants drew on in lexical inferencing are summarized in Table 3. As far as location of clues is concerned, participants mainly used clues from within the T-unit containing the test word, as well as clues from within the test word.

In the category of *intralingual vocabulary knowledge,* participants relied heavily on two aspects: meaning and morphology. The other two aspects, phonological/orthographic forms and syntax, were minimally employed. Altogether, intralingual vocabulary knowledge as a knowledge source was activated 68 times. In contrast, world knowledge was referred to only 16 times, and another main category, interlingual knowledge, did not appear to be activated at all.

Mini-Case Analyses

The learners adopted various approaches in performing their lexical inferencing tasks. In some cases they used varying strategies to infer the meaning of the same word. In the following examples, all involving the test word *free-standing,* inferencing strategies adopted include (a) resorting to

Table 3
Use of Knowledge Sources by All Participants (*n*=12)

Code	Category	No. of times used	Success rate (%)[a]
1	*Location of clues*		
a	within the test word	37	30
b	context within T-unit	40	65
c	context beyond T-unit	8	50
2	*Knowledge of the world*	16	56
3	*Intralingual vocabulary*		
a	*knowledge*		
b	phono/orthographic forms	5	0
c	morphology	26	38
d	syntax	7	57
	meaning	30	60
4	*Interlingual knowledge*	0	—

a. Figures under this heading were derived based on the total number of times that a particular knowledge source was activated. For example, among the seven valid attempts involving use of syntax, four were successful. Therefore, the success rate of using the category of syntax was 4/7 = 57%.

word formation knowledge using clues within the test word; (b) using syntactic and semantic cues within the T-unit to determine the semantic relations between the test word and other words; and (c) a combination of the above. However, whichever strategy was used, it was often critical to have a fairly good understanding of the meaning or grammar of the context, particularly the T-unit in question, so that contextual clues could be effectively used in the inferencing. Having a superior knowledge of morphology was also helpful. Occasionally, morphological knowledge could singlehandedly help solve a problem (see Examples 4 and 5) when clues outside the test word could not be found or used by the learner.

Example 3

[T-unit: aluminum requires special fixing devices or free-standing units.]
Learner: Free-standing units, I don't know what it means. I didn't know, but I can guess from here…. It can stand by itself.
Interviewer: Un huh … So what's the basis for your guess?
Learner: Oh, because … see, "requires special fixing devices, or free-standing units." You can stand up by itself or you can put it together with special fixing devices. That's about it.

> Interviewer: So you just used this part "special fixing device" as the information source to guess the second part?
>
> Learner: Yeah, because it says "or" ... gives you contrast meaning, maybe. That's my guess. (Transcript #48)

In the above attempt, the learner made use of semantic and syntactic clues from the surrounding context of the T-unit. Based on the contextual clues, she concluded that she should look for some meaning that was in contrast to *special fixing device* because the phrase and *free-standing units* were connected by *or*. She therefore came up with the meaning "it can stand by itself."

Example 4

> Interviewer: Okay. Can you guess the meaning of "free-standing" here?
>
> Learner: Device or free-standing unit ... it means some kind of machine or ... I know free, I know standing ... It means can stand without other help. (Transcript #73)

This learner appears to have used her knowledge of word-compounding to reach the conclusion that free-standing means standing by itself.

Example 5

> Learner: Free-standing is like ... device ... like something like option.
>
> Interviewer: Option?
>
> Learner: Make some special ... material ... call special fixing. But the kind of special fixing, yeah I think, I don't know exactly what ... I can guess free-standing, just free, free-standing, don't need another fixing. (Transcript #71)

This learner started with the meaning of the first part of the T-unit and tried to use it as a clue to infer the meaning of free-standing to no avail. Failing that, he simply concentrated on the test word itself and activated his knowledge of word-compounding to obtain the meaning.

Comparing Learners with Varying Depths of Vocabulary Knowledge

This comparison was to determine whether in inferring meanings of unknown words, learners with greater depth of vocabulary knowledge differed from those with less depth of vocabulary knowledge in their patterns of drawing on knowledge sources. The 12 learners were divided into three vocabulary depth groups according to their test results from the *Word Associates Test*. The four top-ranking learners were designated as learners with greater depth of vocabulary knowledge (Group G), those occupying the fifth through eighth ranks as learners with medium depth of vocabulary know-

ledge (Group M), and those occupying the ninth through 12th places as learners with less depth of vocabulary knowledge (Group L).

Comparing Rates of Success

In the interviews, Group G made 21 valid inferencing attempts, among which 14 produced successful guesses. The success rate of Group G was, therefore, 67%. Group M made 18 valid attempts, among which eight were successful. The success rate of Group M was, therefore, 44%. In comparison, Group L made 28 valid attempts, among which eight were successful. The success rate of Group L was, therefore, 29%. Based on these figures, it can be observed that the success rate for Group G was 2.3 times higher than that for Group L, and that the success rate for Group M was close to the average success rate of 45% for the 12 participants collectively.

Examining Knowledge Sources Used

Tables 4 and 5 compare the use of knowledge sources by Groups G and L according to the analytical framework. The category of interlingual knowledge is not included in this comparison as it was not a knowledge source to which the learners referred in their inferencing. The total number of valid attempts made by each group (21 for Group G and 28 for Group L) was used as the basis for deriving percentages so that comparisons could be made. A comparison of Tables 4 and 5 leads to the following findings.

1. Proportionally, Group G made more use of contextual clues (86%) than Group L (68%), but Group L made more use of clues within test words (64%) than Group G (43%).
2. Concerning the use of *intralingual vocabulary knowledge*, Group G mainly concentrated on two aspects of vocabulary knowledge, that is, meaning and morphology, whereas the use of the other two aspects under the same heading, that is, syntax and phonological/orthographic forms, was minimal. In contrast, although meaning and morphology were also the two most frequently used knowledge sources for Group L, learners in this group employed the four aspects of knowledge more evenly. Between the two most heavily used knowledge aspects, meaning and morphology, Group L relied more on morphology (39%) than on meaning (32%), whereas Group G relied much more on meaning (67%) than on morphology (24%).
3. Comparing uses of the meaning category by Groups G and L, it can be observed that although meaning was one of the most heavily employed categories by both groups, the proportion of its use by Group G (67%) was much higher than that by Group L (32%). On the other hand, Group L's proportional use of morphology was more frequent (39%) than that of Group G (24%).

Table 4
Use of Knowledge Sources by Group G

Category	No. of times used	% of 21 VA's[a]	Success rate (%)
Location of clues			
within the test word	9	43%	44%
context within T-unit	16	76%	81%
context beyond T-unit	3	10%	67%
Knowledge of the world	6	29%	67%
Intralingual vocabulary knowledge			
phonological/orthographic forms	0	0%	0%
morphology	7	24%	57%
syntax	2	105	100%
meaning	14	67%	79%

[a]Because participants may use more than one knowledge source in a lexical inferencing attempt, it is possible for the percentages of use of some categories to exceed 100%.

4. In addition, in 18% of the valid inferencing attempts, Group L used phonological/orthographic forms as a knowledge source whereas Group G did not seem to use this source consciously at all.

5. In comparisons of the success rates for each of the knowledge sources used in the inferencing processes, Group G achieved a much higher success rate than Group L in every category. This contrast is especially striking in two categories, syntax and meaning, where Group G's success rates were at least twice as high as those of Group L. It is also noteworthy that although the category of phonological/orthographic forms was used as a knowledge source in 18% of the valid attempts made by the Group L learners, none of their attempts using this category of clues turned out to be successful. The success rate for this group in using morphological clues was also low (36%) relative to that achieved by Group G (57%).

Discussion

Success Rates

By depth-of-vocabulary-knowledge groups, the success rate for Group G was 67%, and that for Group L was only 29%. Other researchers (dos Santos & Sanpedro Ramos, 1993; Morrison, 1996) obtained similar results in their studies in which they divided their learners according to L2 general proficiency levels. Although the basis for grouping learners in this study differs from that used in those other studies, the various findings are still ostensibly

Table 5
Use of Knowledge Sources by Group L

Category	No. of times used	% of 21 VA's[a]	Success rate (%)
Location of clues			
within the test word	18	64%	22%
context within T-unit	14	50%	50%
context beyond T-unit	5	18%	40%
Knowledge of the world	7	25%	43%
Intralingual vocabulary knowledge			
phonological/orthographic forms	5	18%	0%
morphology	11	39%	36%
syntax	4	24%	50%
meaning	9	32%	33%

in agreement because vocabulary knowledge is extensively implicated in practical language skills (Meara & Jones, 1988).

The striking disparity in success rates of learners with varying depths of vocabulary knowledge prompts one to argue that there is a positive relationship between learners' depth of vocabulary knowledge and their ability to succeed in inferring meanings of unknown words in reading. The greater the depth of their vocabulary knowledge, the more likely it is that learners will succeed in inferring the meaning of additional vocabulary when reading English texts. In describing the similar Matthew effect on first language (L1) reading comprehension, Stanovich (1986) argues for a recognition of reciprocal causation in the reading comprehension process when he contends that vocabulary promotes reading comprehension, which in turn promotes vocabulary knowledge. In line with his argument, therefore, it can be safely assumed that a learner with a better vocabulary knowledge in an L2 will achieve better reading comprehension in that language, which in turn will help the learner acquire more vocabulary knowledge. Because lexical inferencing is an important part of the reading comprehension process, the present finding strongly suggests that the Matthew, or rich-get-richer, effect in L1 reading is also applicable to lexical inferencing in L2 reading.

Location of Clues

Results of the data analysis show that clues both within test words and from surrounding contexts were helpful in performing lexical inferencing tasks. On the one hand, clues within test words were frequently used. On the other hand, contextual clues were also used extensively. This indicates the importance of contextual clues (Categories 1b and 1c in Table 3) because 72% (48

occurrences) of the 67 valid inferencing attempts were made with the help of various types of contextual clues. This finding conforms to earlier research results (Haastrup, 1991; Morrison, 1996) that contextual clue was the most used source of clues by learners at both high and low proficiency levels.

However, clues were not used in the same manner by all learners in the present study. The Group G learners used contextual clues on 86% of their inferencing occasions. This percentage decreases to 68 for the Group L learners. On the other hand, the Group L learners used test-word clues in 64% of their valid inferencing attempts. This percentage decreases to 43 for the Group G learners. Nevertheless, it is evident (see Tables 3, 4, and 5) that for both groups the success rates of lexical inferencing based on contextual clues were much higher than those using only clues within test words.

These findings indicate a positive relationship between learners' depth of vocabulary knowledge and their ability to notice and use varying types of contextual clues in inferring meanings of unknown words in reading. The greater the depth of vocabulary knowledge, the better the learner can make use of the context. This better ability to use contextual clues can in turn result in a higher rate of success in lexical inferencing. At the same time, these findings also suggest that learners with less vocabulary knowledge generally concentrate more on clues within the target word than on those embedded in the context.

Use of Knowledge Sources

In general, two main knowledge sources were found to have been drawn on as participants performed their lexical inferencing tasks. In the 67 valid inferencing attempts, *intralingual vocabulary knowledge*, which conceptually represents depth of vocabulary knowledge in the present study, was activated 68 times. In comparison, the only other knowledge source that was used, *knowledge of the world*, was activated only 16 times. This finding suggests that depth of vocabulary knowledge was an important knowledge source in facilitating the completion of lexical inferencing tasks.

Use of Aspects of Vocabulary Knowledge

Among the four analytical categories under *intralingual vocabulary knowledge*, phonological/orthographic forms, morphology, syntax, and meaning, and for the 12 learners collectively, meaning, or lexical semantic information, was the most used knowledge source, activated 30 times in the 67 valid attempts. The second most used source was morphology, which was activated 26 times. The use of the other two sources, phonological/orthographic forms and syntax, was much lower. This finding only partly corroborates the results reported by de Bot et al. (1997) that sentence grammar and word morphology were the most heavily drawn on knowledge sources by their 10 research participants. It is not clear, however, why there were such notable

discrepancies between the two samples involved in their frequencies of using syntactic information in written texts. The difference may be because the two studies adopted varying texts for their experiments, or that the research participants in the two investigations came from varying linguistic and cultural backgrounds.

In terms of the rank order of frequency, the pattern of using these four categories of knowledge sources by Group G conformed in general to the collective pattern described above (see Table 4). However, Group L learners appear to have used these knowledge sources differently: They relied heavily on morphology, and meaning was the second most-used knowledge source for this group (see Table 5).

These findings suggest that Group G's strategies of lexical inferencing were more top-down than those of Group L, whose members on most occasions employed bottom-up approaches. The findings also suggest that although learners with greater depth of vocabulary knowledge can frequently resort to meaning as a major knowledge source in the lexical inferencing process, learners with less depth of vocabulary knowledge are often reduced to looking at the form of the target word itself. This is perhaps because the ability to use meaning as a knowledge source often requires knowing relatively well the meaning of other words surrounding the target word; learners with less depth of vocabulary knowledge were often "hampered by a lack of knowledge of other words in the context of a target word" (Harley, 1996, p. 5). This finding is in accord with Cziko's (1980) report that low-proficiency learners attend more to graphemic form and less to contextual meaning, but it disagrees with the claim (dos Santos & Sanpedro Ramos, 1993; Morrison, 1996) that low-proficiency learners tend to overuse top-down strategies. This discrepancy is probably due to the difference in the participants' varying L1 backgrounds. The L1s of the participants in the present study were Chinese and Korean, languages not cognate with English, whereas the participants in Morrison's study were English-speaking learners of FSL, and the dos Santos and Sanpedro Ramos study involved Portuguese-speaking learners of ESL. Findings from L1 reading research (Stanovich, 1990; Stanovich, Cunningham, & Feeman, 1984) also sheds some light on why learners of varying language proficiencies may adopt varying approaches: Skilled readers rely as much on graphemic cues as less skilled readers, but because skilled readers use up less cognitive capacity than less skilled readers in doing so, they still have the capacity to attend to other types of cue simultaneously.

The present finding that learners with less depth of vocabulary knowledge relied heavily on the form of test words in inferencing corroborates Haynes' (1993) findings that in the absence of adequate contextual clues in lexical guessing, adult ESL learners have a tendency to analyze the form of unknown words, matching their graphemic units to words in their lexical memory. However, for less advanced learners, these strategies often lead to

mismatches and therefore failures. As shown in Table 5, none of the five valid attempts involving only graphemic matching in the category of phonological/orthographic forms was successful.

Implications for ESL Education

Before discussing possible implications of the present findings for ESL education, it is helpful to remind ourselves that this investigation was not carried out in an authentic ESL classroom environment, but rather through the author's individual discussions for research with ESL students. Even so, some implications for classroom learning and teaching can still be generated from findings obtained from the present investigation.

Through investigating ESL learners' use of vocabulary knowledge in lexical inferencing while reading, the present study showed that for ESL learners who are L1 speakers of Chinese or Korean, the dimension of depth of vocabulary knowledge makes an important contribution to the reading comprehension process. This finding points to the benefit and necessity of improving the depth of learners' vocabulary knowledge in ESL learning. The composition of depth of vocabulary knowledge involves a good number of aspects representing various types of linguistic knowledge. It is desirable for educators to incorporate this factor into their curricula and teaching activities. It would also be useful to communicate the importance of depth of vocabulary knowledge to ESL learners through examples, illustrations, or learning activities so that learners will be aware of the benefit of paying attention to aspects of vocabulary beyond superficial meaning recognition while learning English words, and learn to be able to do so effectively.

Recently, encouraging learners to guess word meanings from context has been a popular practice in second-language instruction. The question is, however, whether lexical guessing is effective for learners at every level. Haynes (1993) believes that unless learners have reached a certain proficiency level, they will not be able to achieve much success in lexical inferencing. Results of the present research appear to support this contention; learners with greater depth of vocabulary knowledge made considerably more successful inferences than learners with less depth of vocabulary knowledge. This finding argues that learners should not be urged to make lexical guesses from context at early stages of learning a new language, although of course they may wish or need to do so in some circumstances. The present study demonstrates that even if Group L learners were willing to guess, their guesswork was often not successful, which suggests that premature guessing by less advanced learners tends to be fruitless. Teachers may wish to discourage some low-proficiency ESL learners from starting lexical inferencing prematurely. If a learner reports repeated failures in lexical guessing in context, it is perhaps time for the teacher to determine whether the failures

imply a lack of training in lexical inferencing or simply that the learner is not yet ready to meet such challenges.

Inferencing by no means equals making wild guesses. Making lexical inferences involves the use of a variety of knowledge sources that include not only depth of vocabulary knowledge, but also other sources such as world knowledge. Meanwhile, it also involves the use of contextual clues and clues within target words. Using these clues effectively is a skill that requires long-time honing; it involves developing vocabulary knowledge, as well as other aspects of linguistic knowledge in a well-rounded way. Otherwise, as Haynes (1993) puts it, even if sufficient contextual clues are present, learners will still be unable to make correct guesses simply because they have difficulty in comprehending other words in the surrounding text that provide clues and because they often mismatch word forms and meanings.

In second-language acquisition research, studies (Bardovi-Harlig & Reynolds, 1995; Doughty, 1991; Lightbown & Spada, 1999; Pienemann, Johnson, & Brindley, 1988) reveal that L2 learners often show similar orders for acquiring grammatical rules. If the finding can be extended to the acquisition of aspects of vocabulary knowledge, vocabulary researchers could certainly benefit from this theory. Perhaps thought could be given to identifying a general order for acquiring elements in various aspects of vocabulary knowledge and to addressing the question of whether the developmental sequence of L2 grammar has any relationship with the acquisition of certain aspects of vocabulary knowledge such as graphemes, morphemes, and syntax. If so, how can this relationship inform the development of guidelines for contextualized vocabulary inferencing for L2 learners at varying proficiency levels? These issues could form an agenda for future research.

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